



## VERSION WITH MARKINGS TO SHOW CHANGES MADE

### POWER OPERATED PISTON TOOL WITH PISTON AUTOMATIC RETURN

#### BACKGROUND OF THE INVENTION

##### 1. Field of the Invention

[The object of this invention is] The present invention relates to a power operated piston tool with piston automatic return.

##### 2. Brief Description of the Background of the Invention Including Prior Art

In power operated piston tools, of indirect action, designed for driving fastening elements into a base like masonry, concrete, wood or the like, a piston element, driven by firing gases, coming from firing cartridge, is used as an intermediary element, acting upon the [fastener] fastening element, as opposite to tools of direct action, where firing gases act directly upon the fastening element.

In the tools of indirect action, the piston after fastening is in its forward position, [that is piston shank tip] that its piston tip is at the fastener guide muzzle end. In order to return the piston to its firing position, in conventional, semiautomatic tools, manual reloading is required. This reloading consists of pulling backward the barrel means, having a returning tooth, engaging the respective cavity on piston means, which causes the piston to return. This operation is also used to shift the firing cartridge belt [about] by one position, thus making the tool ready for next firing.

In other kind of power piston tools, described in patent EP 0223740, the piston return is actuated by the firing gases, which, after pushing the piston to its forward position, while still expanding, cause the piston to retract. However, after retracting, the piston strikes against its rear abutment, thus causing the reflection effect, which may displace the piston of some distance from its firing position, creating a dead space, decreasing the firing power of a subsequent fire. As a result, fasteners are driven into the base at uneven depth and the firing chamber becomes spoiled with firing remains, due to incomplete burning of blowing charge. Besides, problems can occur when the piston itself is driven into the base after fastening operation. In that case, to return the piston to its firing position, an additional manual push-rod is needed. In any case, after transporting or other periods of prolonged disuse of the tool, it is always useful to check with manual push-rod, whether the piston is well in its firing position, the only one initial position ensuring tool correct functioning.

In another kind of power piston tool, illustrated in US patent No 3,331,546, to return the piston member, a plurality of stacked washers constructed from polyurethane elastomer, are applied. The washers are positioned within the barrel, on the piston shank. After firing the washers are rapidly collapsed, thus absorbing part of firing energy and functioning as a buffer. At the end of power stroke, and after dissipation of the firing gases, escaping through vent holes in the barrel, the washers will return to their original shape, due to elastic memory, and thus they return a piston to its firing position. The venting holes, situated in washers' side portions cause stress concentration and thus damage to spring elements. The other problem arises when exchanging worn-out washer elements, as they require strictly defined positions and

quantity, otherwise malfunction may occur, if not a serious tool damage.

## **SUMMARY OF THE INVENTION**

### **1. Purposes of the Invention**

It is an object of this invention to provide a power operated piston tool, free from above mentioned imperfections, in which the piston return is carried-out mechanically, by use of one-piece elastic returning bush.

It is another object of the present invention to provide a power operated piston tool in which a piston is correctly positioned in its initial position after firing.

These and other objects and advantages of the present invention will become evident from the description which follows.

### **2. Brief Description of the Invention**

The present invention provides for a power actuated piston tool for driving fasteners into a base like masonry, concrete, wood. The power actuated piston tool with automatic piston return is composed of an external barrel with a guiding barrel and a guide fastener and a piston means moveably mounted in the guiding barrel and the fastener guide. The piston means is formed of a piston shank inserted in the fastener guide and a piston head guided in the guiding barrel. [The] A returning bush is situated on the piston shank between the piston head and the fastener guide[.]. The returning bush is made of elastomeric material and has a shape of [bellow] bellows, whose diameters both external and internal are regularly varied. The walls [of] are so formed that the returning bush [are approximate in shape] approximates to a sinusoid, or to a stack of [frusto-spherical] truncated-spherical segments, or frusto-conical segments, or a stack of [barrel-shape] barrel-shaped segments or/and other [surface of] revolution

segments, creating uniformly spaced swellings and narrowings [of wave like] with a wave-like structure.

The returning bush according to this invention advantageously has [the maximal] a maximum internal diameter of at least one segment at its both ends of a slightly smaller size than the respective diameter of the remaining segments, so the end segment walls are thicker than [others] the other segment walls.

The internal end surface of external segments is markedly curved outside in such a way, that the [position] centre of curvature [points] of the bush ends is clearly distanced from the bush face. The length of the returning bush is selected in such a way that after initial blocking, the piston shank end face does not reach its extreme forward position and remains at a distance from the base, the distance being slightly greater than the head height of the fastening element. The [maximal] maximum external diameter of the returning bush according to the present invention is smaller [enough] than the internal diameter of the guiding barrel, so that, [after] in an initial blocking position of the returning bush, its external diameter still remains smaller than the internal diameter of the guiding bush, thus preserving [the] a slight clearance.

After fully driving [fully] the fastening element into the base, and subsequent stopping of the [piston] piston's movement, the energy accumulated in the returning bush is [being] relieved and [rejects] returns the piston to the rear, due to [shape memory] the shape-memory of the elastomeric material. It is the first and the greatest returning force acting upon the piston. After returning the piston to its rear position, there remains some slight force due to not fully recovering the bush free shape, which force retains the piston in its rear position, [that is] i.e. the firing position.

The novel features which are considered as characteristic for the invention are set forth in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

The object of this invention is illustrated in a preferable embodiment in the accompanying drawings in which fig 1 is a longitudinal cross sectional view of the power piston tool, showing the piston in its firing position, at the moment of firing the cartridge, fig 2 is the same view showing the piston at the end of normal power stroke, at the moment of driving the fastening element into a base, after initial blocking of returning bush, fig 3 is the same view after driving the fastening element fully into the base, fig 4 is the cross sectional view of middle part of the returning bush and fig 5 is somewhat an enlarged view of one of the returning bush [end] ends in the cross section.

### **DESCRIPTION OF INVENTION AND PREFERRED EMBODIMENT**

In a power tool shown in fig 1 a piston 1, mounted for reciprocation within [the] a guiding barrel 2, is in its firing position at the rear end of the guiding barrel 2 where [the] a piston head 12 is proximal [, as near, as possible,] to [the] a firing chamber 4. On the piston shank 11, between the piston head 12 and a fastener guide 5, an elastic returning bush 7 is [situated] mounted, being in the shape of a one piece [bellow] bellows, constructed from [an] elastomer material, whose [diameters] both external and internal diameters are regularly varied. The walls of [so formed] the returning bush 7 [are] approximate in shape to a

stack of truncated-spherical or frusto-spherical segments, creating uniformly spaced swellings and narrowings of [wave like] a wave-like structure. In another embodiment of the invention the returning bush [is of] takes the shape of a stack of frusto-conical segments. In yet another embodiment of the invention, the returning bush [is of] assumes the shape of the stack of [barrel shape] barrel-shaped segments or/and another [surface of] revolution segments. The returning bush 7 has [the maximal] a maximum internal diameter D4, of its extreme two segments at [its both ends,] each end being of slightly smaller size than the respective diameter D2 of the remaining segments, so that the bush end segment walls are a little thicker than the other segments walls. The internal end surface of the external segments is markedly curved outside in such a way, that the position 71 of the curvature points of the bush ends is clearly distanced from the bush faces 72. The length of the returning bush 7 is selected in such a way that after initial blocking of the returning bush 7, the piston shank 1 [end face] end-face does not reach its extreme forward position and remains at a distance from the base 30, the distance being slightly greater than the head height of the fastening element 6. The [maximal] maximum external diameter D1 of the returning bush 7 is sufficiently smaller [enough] than the internal diameter of the guiding barrel 2, that, after initial blocking of the returning bush 7, its external diameter still remains smaller than the internal diameter of the [guiding bush] guiding barrel 2, thus preserving a slight clearance. When the piston 1 is in its firing position, an initial stress within the returning bush 7 remains, enough to ensure that the piston head 12 abuts the bottom of the barrel 2, near the firing chamber 4. On the piston head 12 there [is a plurality of grooves] are multiple grooves 121, acting [as sealing means for firing] to seal the gases created

during firing and providing some space to gather impurities. Ports A in the guiding barrel 2 and ports B and C in the external barrel 8 are provided to enable the firing gases [evacuation] to be discharged after firing.

After firing the cartridge 9 upon striking the firing pin 20, the firing gases set the piston 1 into motion, with rapidly accelerating velocity, towards the fastener 6. [Piston] The piston head 12, after passing the port A, opens the gas flow connection toward the space between the guiding barrel 2 and the external barrel 8 and from there, through port B, toward [silencer 11] silencer 81 and from there, via port C, [into the] to atmosphere, thus reducing the firing noise and the gas pressure in the firing chamber, to a value close to atmospheric pressure. [Accelerated] The accelerated piston 1 strikes against the fastener 6, driving it into the base 30, and at the same time, compressing the returning bush 7. At a distance of several [millimeters] millimeters before fully setting the fastener 6 into the base 30 initial blocking of the returning bush 7 takes place. In this position the piston shank 1 [and face] end-face does not reach its extreme forward position and remains at some distance from the base 30, slightly greater than the head height of fastener 6 and a clearance exists between the [guiding] guiding barrel 2 and returning bush 7. The returning bush 7, at the final stage of the [piston 1] piston's motion, forms a [shut] closed tubular column, thus absorbing little firing energy, which ensures driving the [fastening element] fastener 6 to [the] its full depth. In the event of free flight shot or overdrive of the piston, this shut tubular column will function as a buffer, to absorb the high energy of the piston 1.

After [thrusting] driving the fastener 6 into the base 30, the piston 1 stops and due to elastic memory, inherent in elastomeric material, the returning bush 7 will return the piston 1 to its firing

position, where it is ready for the next firing operation. [ , the more easier that] This is facilitated because the counter-pressure acting upon the piston 1 from the firing chamber 4, has fallen to atmospheric pressure.

To reload the power piston tool, it should be removed from [the] contact with the base 30, then the springs of the firing-pin assembly move the subassembly of piston 1 and its guiding barrel 2 forward [ , about] by a stroke, enabling: first [to remove the used firing] the removal of the fired cartridge 9 from the firing chamber 4 and, secondly, after the tool is pressed anew against base 30 for the subsequent firing, to shift the cartridge belt 40 [about] by one position.

By virtue of the particular configuration of the elastic returning bush 7, during the normal power stroke, substantially little energy will be absorbed by the returning bush 7 being pressed, and thus there will be little interference with the velocity of the piston 1, so the bulk of the firing energy is used [for driving] to drive the [fastener 7] fastener 6 into the base 30, while only a small portion of this energy will be used for returning the piston 1 to its firing position, thus reducing the tool [reflection] recoil effect and ensuring that the piston 1, will always return to its firing position, after venting the space behind its head 12. The particular [wave like] wave-like shape of the returning bush 7, as well as, thickening the returning bush 7 end segments and the particular position of curvature points of the ends of the returning bush 7 [ends] ensures correct functioning of the tool and eliminates the elastomeric bush tendency to curl, which tendency could [drive] lead to a situation when the piston 1 could be blocked within the guiding barrel 2. Besides, the returning bush 7 does not oppose a great resistance to the piston 1 movement, so it does not [brake] reduce its velocity and it does not impair the



effectiveness of [fastening] placing the fasteners and does not provoke any tool [reflection] recoil effect.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of piston tools differing from the types described above.

While the invention has been illustrated and described as embodied in the context of a power actuated piston tool with an automatic piston return, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.